

CLAIMS

1. An exposure method for exposing an identical location of a substrate being exposed a plurality of times through a mask formed with a pattern while giving different amounts of exposure to the substrate by pulse light at a plurality of positions or position regions in the direction in which the substrate is irradiated by the pulse light, comprising a step of setting an energy of the pulse light so that the cumulative number of pulses of the pulse light at the position or position region giving the maximum amount of exposure among the plurality of positions becomes at least a predetermined number of pulses.

2. An exposure method as set forth in claim 1, wherein the predetermined number of pulses is set to a number of an extent able to be ignored relative to a targeted exposure accuracy obtained by averaging the variations in energy of the pulses of the pulse light.

3. An exposure apparatus comprising:
an adjustment device which adjusts an energy of pulse light irradiating a mask formed with a pattern;

a projection optical system which projects

an image of the pattern of the mask on a substrate;

a stage which moves the substrate in an optical axis direction along the optical axis of the projection optical system; and

5 a control device which controls for exposing an identical location of said substrate a plurality of times while moving the stage in said optical axis direction and changing the amount of exposure by the pulse light in accordance with the position or position region of the stage, and controls
10 the adjusting device so that a cumulative number of pulses of said pulse light at the position or position region giving the maximum amount of exposure among the plurality of positions of the stage becomes at least a
15 predetermined number.

4. An exposur method comprising:

a first movement step of moving a substrate being exposed so that its position in an optical axis direction along a projection optical axis becomes in
20 register with a reference position based on a detection value detected by a focus detection device having an effective detection area of a predetermined range in said optical axis direction at a shift position shifted in a plane orthogonal to the
25 projection optical axis from an exposure position to

be exposed through a mask formed with a pattern on said substrate;

a second movement step of moving said substrate in said plane orthogonal to the optical axis so that the exposure position becomes in register with a projection position of an image of a pattern of the mask;

a changing step of changing said reference position so that the reference position becomes in register with the position of the substrate in the optical axis direction based on the detection value detected by the focus detection device at the exposure position; and

an exposure step of exposing the same location of the substrate through the mask while moving the substrate in the optical axis direction in accordance with the detection value of the focus detection device.

5. An exposure method as set forth in claim 4, further comprising, in said exposure step, performing exposure while moving the substrate continuously in the optical axis direction.

6. An exposure method as set forth in claim 4, further comprising, in said exposure step, performing exposure a plurality of times intermittently while

moving the substrate in steps in the optical axis direction.

7. An exposure apparatus comprising:

5 a projection optical system which projects an image of a pattern of a mask irradiated by exposure light on a substrate;

10 a stage which moves said substrate in an optical axis direction along an optical axis of said projection optical system and in a plane orthogonal to the optical axis substantially orthogonal to the optical axis direction;

15 a focus detection device having an effective detection area of a predetermined range in said optical axis direction and detecting a position of said substrate in said optical axis direction at a projection position of said projection optical system; and

20 a control device which controls the stage to move the substrate so that its position in the optical axis direction becomes in register with a reference position based on a detection value detected by said focus detection device in a state setting a shift position shifted in said plane orthogonal to the optical axis from the exposure position to be exposed
25 through said mask on said substrate at said projection

position, changes the reference position so that the reference position becomes in register with the position of the substrate in the optical axis direction based on the detection value detected by the focus detection device in the state setting the exposure position to the projection position, and exposes the same location of the substrate through the mask while moving the substrate in the optical axis direction in accordance with the detection value of the focus detection device.

8. An exposure apparatus as set forth in claim 7, wherein said control device performs control so as to expose while moving the substrate continuously in the optical axis direction.

9. An exposure apparatus as set forth in claim 7, wherein said control device performs exposure a plurality of times intermittently while moving the substrate in steps in the optical axis direction.

10. An exposure apparatus as set forth in claim 7, wherein said focus detection device comprises a sensor for detecting a position of said substrate in said optical axis direction by detecting a shift, from said reference position, of an imaging position of detection beam irradiated on said substrate and reflected at said substrate and a reference position

adjusting device provided on an optical path of said detection beam for adjusting an imaging position of said detection beam on said sensor.

11. A process of production of a device
5 comprising a step of exposing a substrate using an exposure method as set forth in claim 1.

12. A process of production of a device
comprising a step of exposing a substrate using an exposure method as set forth in claim 4.

10 13. A process of production of a device
comprising a step of exposing a substrate using an exposure apparatus as set forth in claim 3.

14. A process of production of a device
comprising a step of exposing a substrate using an exposure apparatus as set forth in claim 7.
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